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CONTENTS OF No. 98.

	PAGE
A Naturalist's Year. The Barn Owl Flies. By Grant Allen	161
Pleasant Hours with the Microscope. (*Illus.*) By H. J. Slack	163
The Harvest Moon. (*Illus.*) By R. A. Proctor	164
The Chemistry of Cookery. XVIII. By W. Mattieu Williams	165
The Morality of Happiness. By Thomas Foster	166
Evolution of Human Physiognomy. (*Illus.*) By E. D. Cope	168
Tricycles	169
Winds as Projectiles	170
Dangers of Sea Bathing	171
Editorial Gossip	171
Face of the Sky	172
Correspondence: The Bennett Battery — Small Wheels for Tricycles — A Curious Phenomenon—The Comma, &c.	173
Our Mathematical Column	175
Our Whist Column	175
Our Chess Column	176

A NATURALIST'S YEAR.

By GRANT ALLEN.

XXI.—THE BARN OWL FLIES.

AS the shades of evening begin to fall, the big barn owl, from the top of the old broken sham-castle on the hill-side, crawls out regularly every night from the over-sheltering ivy, and sets forth stealthily upon his predatory expedition in search of stray wandering rabbits, rats, and mice. A weird and uncanny thing he is to be sure, worthy to be held in superstitious awe as a bird of ill-omen; and yet, I suppose, he merely flies by night from necessity, not from choice, because the creatures on which he has adapted himself to prey come out by night for their own feeding-time. Your common barn owl, in fact, is one of the remoter hangers-on of civilisation, an outcast who follows close on the heel of the agricultural pioneer all the world over, till at last it has become almost impossible to say in what countries he is really indigenous, and in what he is merely a perfectly naturalised alien. The reason for this is simple and obvious enough. Wherever man sows and plants, the rat and the mouse, in one or other of their local forms, thrive and multiply most exceedingly. Not only in houses, but even more in cornfields, barns, farmyards, and granaries, these unwelcome guests of civilisation flourish everywhere in the greatest abundance. Now, the barn owl was from the very beginning, apparently, the member of his own race most peculiarly adapted to prey remorselessly upon these small and comparatively defenceless quadrupeds. So, as the mice, rats, and shrews increased in numbers with the increasing supply of food afforded them by the grain or the insects of cultivated fields, in like manner did the predaceous barn owls increase side by side with them to prey upon them, as their natural food. All the owls, in common with other birds of prey, have a convenient habit of rejecting the bones of their victims from the stomach, undigested, in little pellets, which saves their alimentary canal a lot of useless labour; and the examination of these pellets, in the case of our friend the barn owl, sufficiently dispels the wicked calumny of gamekeepers that he feeds mainly upon young birds, as the bones of which they are composed are almost entirely those of small mice, voles, shrews, and other petty rodents or insectivores.

Though it is not quite formally correct to describe the owls, after the good old fashion, as the nocturnal birds of prey (for some of them hawk about in the broad daylight, while at least one of the falcon tribe, or so-called diurnals, has, *per contra*, acquired the habit of hunting bats by night), there can yet be no doubt that the owls as a group have really gained most of their distinguishing characteristics in adaptation to a night-flying existence. Their very shape and structure marks them out at once as widely different in habit from the frank and bold birds of prey, like the eagles, hawks, and falcons, which mostly pursue their quarry in the open sky. Their oddly-shaped legs fit them for squatting in the peculiar, sleepy, owlish attitude; their short necks and clumsy bodies are better fitted for prowling in the dusk after ground animals and game birds, than for pursuing swiftly-flying creatures like those which form the main food of the rapid hawks and falcons. But the big head, with its ruff-like disc, which is perhaps the most marked feature in our common English owl, bears still more distinct reference to the specially nocturnal habits of the entire race. Owls, apparently, are more highly developed hawks, specialised in many respects for night-flying habits; and therefore their sense-organs have had to undergo the usual modifications in adaptation to their peculiar environment. As in most lemurs and other advanced nocturnal mammals, the eyes are very large and noticeable, and are surrounded by a sort of reflector of curiously-arranged concentric feathers. They are admirably adapted for vision in the dusk or with a minimum of light; but, at the same time, the peculiar organs in the retina which are supposed to be employed in the perception of colour are entirely absent. It is a noteworthy fact in this connection, that owls themselves seldom show any traces of colour in their own plumage, other than various shades of black, white, grey, and brown. Their hues are generally protective, and enable them to pass unnoticed in the daytime upon the bark of trees. This is, indeed, what one might naturally expect, because Mr. Darwin has shown that ornamental colouration in birds is due almost entirely to the sexual selection of the most beautiful mates; and a group like the owls, which are actually destitute of the nervous apparatus for perceiving red, blue, green, and yellow, cannot well show a marked preference for such gaudy hues in their own fellows. As a matter of fact, the few decorative adjuncts to be found amongst them are entirely confined to pure white plumage, as in the snowy owl (a day-flyer), or to tufts and rings of feathers in the most conspicuous and visible positions, as in the long-eared owl of our own islands. In this respect, owls form a complete contrast to such brilliant fruit-eating groups as the parrots or the toucans; yet it is interesting to observe that one very aberrant New Zealand parrot, which is also nocturnal in its habits, and closely resembles the owls in appearance, down even to the possession of the distinctive disc around the eyes, has toned down the prevailing green of its ancestral colouration into a very owl-like shade of dingy olive-brown, speckled with tawny yellow. This is one of the numerous cases which show us that similarity in mode of life will produce strong adaptive external resemblances between very diverse creatures originally descended from extremely unlike ancestral lines.

Nocturnal animals require largely to supplement sight by hearing, a fact which is well illustrated in the enormous external ears and peculiar appendages of many advanced forms of bats. In the owls, evidence of similar adaptation

XUM

is not wanting. The external ear-opening is extremely complicated, and its peculiarities are different in different genera of owls. One kind even has the ear-opening on the right side of a different shape from that on the left. Everybody who has ever watched our English barn owl closely, knows well that its sense of hearing is most keen and acute. It is, doubtless, this large development of the exterior sense-organs that makes the heads of most owls so disproportionately big. There is one peculiarity of the whole owl group, however, which they share with a single other bird of prey—the osprey—and which does not seem immediately connected in any way with their nocturnal habits, though it fits in admirably with their usual skulking mode of life, and that is, the power which they possess of reversing their outer toe, so as to turn it outwards or inwards at will. A peculiarity like this must probably descend to them from a common ancestor, who perhaps was not yet nocturnal in his mode of life. As a consequence, owls can sit with two toes on one side of the perch and two on the other, a thing impossible for hawks and eagles, whose toes are arranged to go three on one side and one on the other.

Our own common barn owl is a good representative of the usual habits prevalent among the race at large; but, like most other successful groups, the owls have split up into a good many genera and species, several of which have diverged considerably in structure, and still more in habits, from the central type. While most of them hunt rats and mice, and such small deer, the great eagle-owl of Germany and Switzerland eats not only rabbits, hares, capercailzie, and pheasants, but even so large an animal as the fawn of the roebuck. Other owls, again, have taken to fishing, like their distant relative, the osprey; and, like him, they have lost the feathers on the lower part of the leg, and acquired a series of small spikes on the sole of the toes, to aid them in holding their slippery prey. One of these is common in India, and three rarer kinds frequent the streams and inland lakes of Africa. A few owls have even reverted once more to the habit of hunting their food by day, like the snowy owl, which is perhaps the handsomest member of the entire race. Some of the tiny continental species have greatly degenerated in size, till they have grown no bigger than an ordinary robin. Such decrease of size, though it looks at first sight like a disadvantage, may really help a species in the struggle for existence by enabling it to procure smaller but more abundant food. The wee pigmy-owlet of the Mediterranean region could easily pick up a livelihood for himself in many districts where the great eagle-owl, adapted to broad, forest-clad plains, would starve hopelessly.

Herbert Spencer.—"The work which Herbert Spencer has done in organizing the different departments of human knowledge, so as to present the widest generalizations of all the sciences in a new and wonderful light, as flowing out of still deeper and wider truths concerning the universe as a whole; the great number of profound generalizations which he has established incidentally to the pursuit of this main object; the endless rich and suggestive thoughts which he has thrown out in such profusion by the wayside along the course of this great philosophical enterprise,—all this work is so manifest that none can fail to recognise it. It is work of the calibre of that which Aristotle and Newton did, though, coming in this latter age, it as far surpasses their work in its vastness of performance as the railway surpasses the sedan-chair, or as the telegraph surpasses the carrier-pigeon."—John Fiske.

PLEASANT HOURS WITH THE MICROSCOPE.

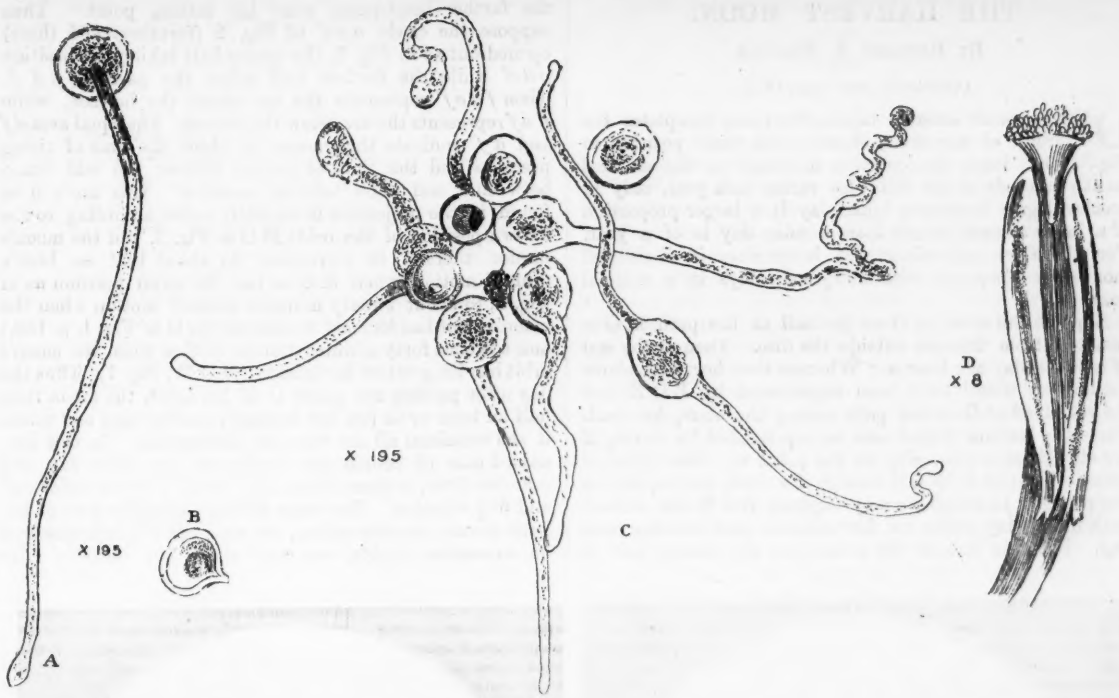
By Henry J. Slack, F.C.S., F.R.M.S.

Everybody knows that in the middle of an ordinary flower, say a geranium or a lily, there rises a column, usually slender, with a peculiar formation at the top. In the scarlet geranium this is five-fingered, in the lilies more knobby and with three divisions. The column is the style and the organ at the top the stigma. The two constitute the pistil. In a perfect flower the observer will notice a series of whorls, forming the calyx, the corolla, a group of filaments bearing anthers and surrounding the pistil, and, lastly, the pistil itself, more or less elongated, but in all cases rising from the simple or compound ovary. It is very interesting to notice the shape of these parts in various flowers. There is great variety in the anthers and in the stigmas, but the function of the former is always to produce the pollen or male element, and the stigma is adapted to receive it, and cause it to convey some of its contents to the ovules in the ovary.

Pollen is of various sizes and shapes—frequently round and frequently oval, or shuttle-shaped. In the melon it is round and spiked like a horse-chestnut, and provided with circular lids at certain spots. The passion-flower (*P. cærulea*) has round pollen, covered with a network pattern, and provided with large lids. The musk plant, chicory, mallow, and many others exhibit interesting varieties of shape, and the "Micrographic Dictionary," pl. 32, gives a figure of the pollen of *Basella alba* like a square box, with the appearance of a round hole in the middle of each side. Many sorts of pollen look under the microscope as if they had holes in them, or slits, but these appearances probably in all cases arise from those parts being thinner or more transparent than the rest. When the pollen sprouts it is from these spots, and in those which have lids the outgrowth forces them open.

The stigma is provided with several means of holding the pollen conveyed to it. It is roughened with glandular papillæ in the scarlet geranium, and in many plants when it is ready for the pollen it pours out a glutinous secretion. It would lead us away from our present object to describe the various contrivances by which plants avoid self-fertilisation, and the different ways, by insect help and otherwise, through which they receive pollen from other individuals. Let us suppose a pollen cell deposited upon a stigma. It finds itself stimulated to put forth a slender outgrowth, which has to work its way down the style and reach the ovule it is intended to fertilise. Some plants (gourds for example) enable this process to be traced, but only skilled observers and dissectors are likely to see much.

Plants of the lily family offer the easiest means of seeing the growth of pollen tubes. A little pollen should be placed on a glass slide in a drop of the fluid secreted by the stigma, lightly covered with thin glass, and steadily watched. *Lilium excelsum*—the pretty, sweet-scented, buff lily—and *L. Auratum* are recommended. The sketches given with this paper represent what occurred with the pollen of a very beautiful plant now frequently found in conservatories, and belonging to the Ginger family. It is called *Hedychium Gardnerianum*. A fine specimen in full flower is a splendid sight. The one in question exhibited a broad head of flowers nearly a foot high. Each corolla consists of six segments in two rows, the sixth being the biggest, with a notched lip. The arrangement of the anther and style is shown in Fig. D. The two lobes of the anther clasp the style and lower part of the stigma, which rises above them. The filament bearing the anther is



grooved, and the style runs up it. When a corolla is fading, a gentle pull will draw out the style, and it is found to be very slender. The filaments are deep orange red, the petals bright pale yellow. This makes an elegant contrast, and the plant exhales a delicious scent of a honey-and-ginger character. To see it to perfection it should be placed in a sitting-room window, or cool corner of a conservatory, as soon as any of the flowers begin to open. With such treatment it will display its beauty for several days, while in a hot place the corollas that first open fade before the others are ready, and a shabby appearance is produced. A honey fluid drops freely from the stigmas, and is very viscid. Taking some of the pollen and putting it in this fluid slightly diluted with water, generally succeeded on a bright day in inducing some of the pollen cells to sprout. At first a little projection was found, as at B. This was quite clear and glassy. It gradually elongated into a tube, a clear space being always in advance, which showed the vital action to be in the tube walls. They were not pushed forward by the granular matter, but that waited for their growth, and then entered into the space provided for it. A represents one of the best developed tubes formed in the course of a few hours; C, a group of pollen cells and tubes, one cell emitting a tube on opposite sides. Very often, instead of forming a regular-shaped tube, the pollen cell allowed the granular matter to escape in the forms shown by two cells, one on the right and the other on the left in the figure. That on the left was a mess from the beginning —that on the right began well and ended in a zigzag muddle. A represents the nearest approach to the right thing, but probably the tube is more slender when it grows out of the cell under natural conditions.

Botanists distinguish the outer coating of the cell as *extine*, and the inner layer as *intine*. The intine forms the tube, and the granular matter undergoes a development which fits it for the work of fertilisation. The time it takes for a pollen tube to develop varies with different plants. Ultimately it gets into an ovule through a small entrance (micropyle), and proceeds to its special work more quickly or slowly, according to the nature of the plant. Sachs observes:—"The time that intervenes between pollination and the entrance of the pollen tube into the micropyle depends not only on the length of the style, which is often very considerable (as in zea and crocus), but also on the specific characters of the plants. Thus, according to Hoffmeister, while the pollen tubes of *crocus vernus* only requires from twenty-four to seventy-two hours to penetrate the style, which is from five to ten centimètres in length,* those of *Arum maculatum* take at least five days, although the distance they have to go over is scarcely more than 2 or 3 mm.†, and those of *Orchideæ* require ten days, or even several weeks or months, during which time the ovules first become developed in the ovary, or even are not formed till then." When the pollen tube has reached its destination, the development it induces may be quick, or, as is the case with many trees, may take weeks, or months. In the meadow saffron (*Colchicum autumnale*) Hoffmeister finds the pollen tubes enter at the latest at the beginning of November, but it is not till the May following that the formation of the embryo begins.

The experimenter with pollen grains must not expect uniform success. Operating with those of the Hedychium several failures were encountered, and on a dull day without any instance of success. If the pollen cell shows no inclination to make the little bulge that is the commencement of a tube in an hour or so, it is well to begin again with a fresh lot. The pollen grains should not be too thickly crowded, and the viscid fluid only thinned just enough to flow freely amongst them. In some plants the fluid of the stigma may not require this, and it is as well to try it in the state in which it is exuded.

* 10 centimètres = 3·937 inches.
† A millimètre = 0·039 of an inch; 26 are rather more than 1 in.

XUM

THE HARVEST MOON.

By Richard A. Proctor.

(*Concluded from page* 157.)

ONCE in each sidereal month the moon completes the circuit of her orbit, shown in its mean position in Fig. 2, the lunar day varying in length as the sidereal month proceeds as the solar day varies each year, only in greater degree because a lunar day is a larger proportion of a lunar sidereal month than a solar day is of a year. For, there are only about $26\frac{1}{2}$ lunar days in a sidereal month, as compared with $365\frac{1}{4}$ solar days in a sidereal year.

Suppose the moon at O on the half of the path M O *m* remotest from the eye outside the disc. Then at the end of a lunar day she is at *n*. Whereas then her path above the horizon would have been represented by E O E′ had she remained at O on her path among the stars, her path above the horizon would now be represented by *a n a′*, if she stayed for a lunar day at the point *n*. Her point of rising will be at *k*, nearly enough for such an inquiry as the present, in which we may suppose E O E′ her diurnal path in one day, and *a n a′* her diurnal path on the next day. She rises then at the point *k* on the nearer half of the farther hemisphere were her setting point.* Thus suppose the circle *a c a′* of Fig. 2 (foreshortened there) opened out as in Fig. 3, the nearer half taking the position *a d a′* while the farther half takes the position *a d′ a′*. Then *f d a f′* represents the arc above the horizon, while *f′ a f* represents the arc below the horizon. The equal arcs *d f* and *d′ f′* indicate the amount by which the time of rising precedes and the time of setting follows the mid times between *a′* and *a* and between *a* and *a′*. This arc will be found, if the projection is carefully made according to the known position of the orbit M O *m* Fig. 2, and the moon's motion therein, to correspond to about half an hour's diurnal motion when M O *m* has its mean position as in Fig. 2, to about twenty minutes diurnal motion when the moon's orbit has its least inclination (*m* O *m′* Fig. 1, p. 156,) and to about forty minutes diurnal motion when the moon's orbit has its greatest inclination (M O M′, Fig. 1). Thus the day after passing the point O of her orbit, the moon rises half an hour or so (on the average) earlier than she would if she remained all the time on the equator. In this last-named case of course she would rise day after day $50\frac{1}{2}$ minutes later, a mean lunar day being 1 mean solar day and $50\frac{1}{2}$ minutes. But when at this particular part of her path around the star sphere, she rises not $50\frac{1}{2}$ minutes later on successive nights, but only about $20\frac{1}{2}$ minutes later

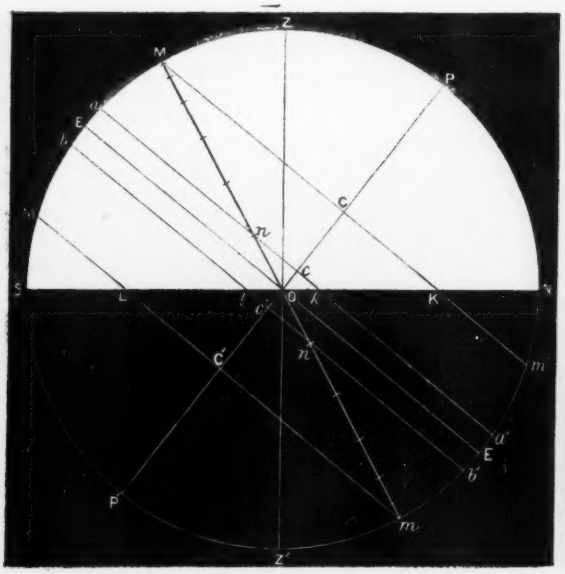


Fig. 2 *bis*.

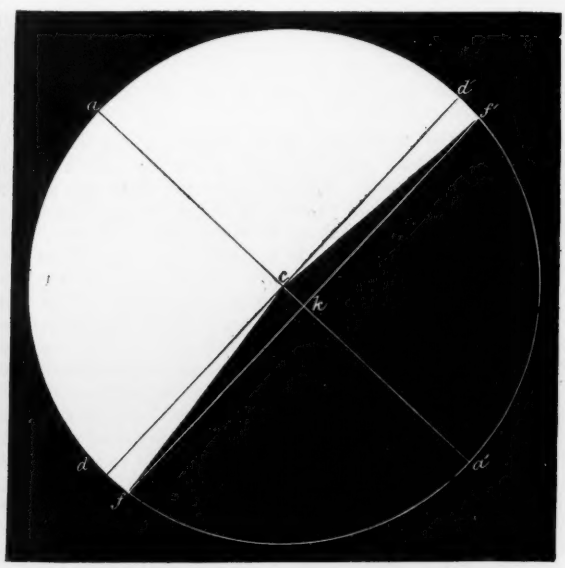


Fig. 3.

the sphere S Z N Z′, is carried to *a* her highest point above the horizon, and passes down to the western horizon at *k* again; then below the horizon to *a′* and so back to *k* again,—though in reality by this time she has reached (in her path round the stellar heavens) the mark on O M next beyond *n*.

Manifestly then the moon rises sooner and sets later in traversing the diurnal path *a* O *a′* than in traversing the diurnal path E O E.′ The straight line *k c*, is in reality the foreshortening of the arc by which the time of rising precedes what it would be if the middle point *c* (on the nearer hemisphere) of her half circuit *a c a′* were her rising point; *k c* is also the foreshortening of the arc by which her time of setting follows what it would be if *c* on because her movement northwards from the equator makes her rise about 30 minutes earlier than she otherwise would.†

* I take this opportunity to correct what I find to be a prevalent error,—the supposition that the sun is due east at six o'clock in the morning, and due east at six o'clock in the evening, all the year round. A moment's study of Fig. 2 which gives the sun's path *M O m* among the stars (as well as the moon's), shows that the points occupied by the sun at six morning and evening, which of course lie along the circle *P O P′* (since this circle divides every transverse semicircle as *a c a′*, *M C m′* into equal arcs) are to the north of east and west from the vernal equinox to the autumnal, and to the south, of east and west from the autumnal equinox to the vernal.

† The sun when at the corresponding part of *his* orbit, namely at the vernal equinox, rises earlier by about $2\frac{1}{2}$ minutes on successive days and sets about $2\frac{1}{2}$ minutes later, so that the interval between successive sunrises is less at this time than a mean solar day and at

This happens once in every sidereal lunar month, and may happen more than once in each ordinary lunar month, because the sidereal month is shorter than the lunation, and if the moon is at O very soon after the beginning of a lunation she will be again at O very soon after the end of the lunation,—or pass O twice in that lunar month. But it *must* happen once at least.

We only notice the successive risings of the moon at nearly the same hour, however, when she is conspicuous,—that is, when she is full. We have to consider then at what part of the year she will be full when at O (on the farther hemisphere of Fig. 2), crossing the equator ascendingly, or from south to north. This is a simple matter to determine. As the moon is opposite the sun when full, it follows (since her path is, nearly enough for our present inquiry the same as the sun's), that if when full she is crossing the equator ascendingly from south to north, he must be near the opposite part of their common path, or crossing the equator descendingly from north to south. This is where the sun is at the time of the autumnal equinox. Consequently that full moon which occurs nearest to the autumnal equinox, or say to September 23 or 24, is the full moon which of all the full moons in the year rises on successive nights most nearly at the same time. [I am quite aware of the inexactness of the wording in this sentence. The moon is only full at a certain moment. But I am speaking of phenomena as seen by harvestmen and field labourers, to whom the moon is full as long as her face looks round.]

The full moon which thus rises nearly at the same time on successive nights is called the harvest moon, because her so rising is often convenient to harvest men. Often however, (oftener indeed than not to the harvest men at any given spot) the harvest moon occurs at such a time as not to be of any special use in the way indicated. For instance where I am writing (on September 6th) the harvest is already gathered,—the moon being not as yet half full. Harvest moon occurs on the 16th and will be of no special advantage in this locality. *Last* full moon, which was not harvest moon, was good enough in many places to serve all the purposes of a harvest moon.

To correspond to lower latitudes than ours, the point S in Fig. 2 should be taken lower and the point N higher. For higher latitudes the point S should be higher and the point N lower. For the Arctic circle the point S should be at M′ the point N at *m′*.

The same reasoning applies, with a change of seasons by half a year, to the southern hemisphere. The same figure would serve in fact if S and N be interchanged. The harvest moon is manifestly as useful in the southern hemisphere as in the northern, and within similar limitations. All the lunar phenomena in the southern hemisphere are precisely the same for every latitude as for the corresponding latitude in the northern hemisphere,—when we simply write southern for northern, and speak of spring, summer, fall, and winter, instead of naming the months (which correspond to different seasons in the two hemispheres).

In the German Empire, exclusive of Hungary, last year 139,452 railroad servants were examined as to their capacity to distinguish colours. Of these, the *Railroad Gazette* says, 998, or 0·72 per cent., were found to be colour blind. Of 115,154 examined this year, only 46 were wholly and 273 partly colour-blind—0·28 per cent. of the whole number.

its shortest, while the interval between successive sunsets is greater than a mean solar day, and at its longest.

THE CHEMISTRY OF COOKERY.

XVIII.

By W. Mattieu Williams.

I FIND that Sir Henry Thompson, in a lecture delivered at the Fisheries Exhibition, and now reprinted, has invaded my subject, and has done this so well that I shall retaliate by annexing his suggestion, which is that fish should be *roasted*. He says that this mode of cooking fish should be general, since it is applicable to all varieties. I fully agree with him, but go a little further in the same direction by including, not only roasting in a Dutch or American oven *before* the fire, but also in the side-ovens of kitcheners and in gas-ovens, which, when used as I have explained, are roasters, *i.e.*, they cook by radiation, without any of the drying anticipated by Sir Henry.

The practical housewife will probably say this is not new, seeing that people who know what is good have long been in the habit of enjoying mackerel and haddocks (especially Dublin Bay haddocks) stuffed and baked, and cod's heads similarly treated. The Jews do something of the kind with halibut's head, which they prize as the greatest of all piscine delicacies. The John Dory is commonly stuffed and cooked in an oven by those who understand his merits.

The excellence of Sir Henry Thompson's idea consists in its breadth as applicable to *all fish*, on the basis of that fundamental principle of scientific cookery on which I have so continually and variously insisted, viz., the retention of the natural juices of the viands.

He recommends the placing of the fish entire, if of moderate size, in a tin or plated copper dish adapted to the form and size of the fish, but a little deeper than its thickness, so as to retain all the juices, which by exposure to the heat will flow out; the surface to be lightly spread with butter and a morsel or two added, and the dish placed before the fire in a Dutch or American oven, or the special apparatus made by Burton of Oxford-street, which was exhibited at the lecture.

To this I may add, that if a closed oven be used, Rumford's device of a false bottom, shown in Fig. 3, of No. 11 of this series, should be adopted, which may be easily done by simply standing the above-described fish dish, with any kind of support to raise it a little, in a larger tin tray or baking dish, containing some water. The evaporation of the water will prevent the drying up of the fish or of its natural gravy; and if the oven ventilation is treated with the contempt I have recommended, the fish, if thick, will be better cooked and more juicy than in an open-faced oven in front of the fire.

This reminds me of a method of cooking fish which, in the course of my pedestrian travels in Italy, I have seen practised in the rudest of osterias, where my fellow guests were carbonari (charcoal burners) waggoners, road-making navvies, &c. Their staple "*magro*," or fast-day material, is split and dried cod-fish imported from Norway, which in appearance resembles the hides that are imported to the Bermondsey tanneries. A piece is hacked out from one of these, soaked for awhile in water, and carefully rolled in a piece of paper saturated with olive oil. A hole is then made in the white embers of the charcoal fire, the paper parcel of fish inserted and carefully buried in ashes of selected temperature. It comes out wonderfully well-cooked considering the nature of the raw material. Luxurious cookery *en papillote* is conducted on the same principle and especially applied to red mullets, the paper being buttered and the sauce enveloped with the fish. In all these cases the retention of the natural juices is the primary object.

XUM

I should add that Sir Henry Thompson directs, as a matter of course, that the roasted fish should be served in the dish wherein it was cooked. He suggests that "portions of fish, such as fillets, may be treated as well as entire fish; garnishes of all kinds, as shell-fish, &c., may be added, flavouring also with fine herbs and condiments according to taste." "Fillets of plaice or skate with a slice or two of bacon; the dish to be filled or garnished with some previously-boiled haricots," is wisely recommended as a savoury meal for a poor man, and one that is highly nutritious. A chemical analysis of sixpennyworth of such a combination would prove its nutritive value to be equal to fully eighteenpennyworth of beefsteak.

Some people may be inclined to smile at what I am about to say, viz., that such savoury dishes, serving to vary the monotony of the poor hard-working man's ordinary fare, afford considerable moral, as well as physical, advantage.

An instructive experience of my own will illustrate this. When wandering alone through Norway in 1856 I lost the track in crossing the Kyolen fjeld, struggled on for twenty-three hours without food or rest, and arrived in sorry plight at Lom, a very wild region. After a few hours' rest I pushed on to a still wilder region and still rougher quarters, and continued thus to the great Jostedal table-land, an unbroken glacier of 500 square miles; then descended the Jostedal itself to its opening on the Sogne fjord—five days of extreme hardship with no other food than flatbrod (very coarse oatcake), and bilberries gathered on the way, varied on one occasion with the luxury of two raw turnips. Then I reached a comparatively luxurious station (Ronnei), where ham and eggs and claret were obtainable. The first glass of claret produced an effect that alarmed me—a craving for more and for stronger drink, that was almost irresistible. I finished a bottle of St. Julien, and nothing but a violent effort of will prevented me from then ordering brandy.

I attribute this to the exhaustion consequent upon the excessive work and insufficient unsavoury food of the previous five days; have made many subsequent observations on the victims of alcohol, and have no doubt that overwork and scanty, tasteless food is the primary source of the craving for strong drink that so largely prevails with such deplorable results among the class that is the most exposed to such privation. I do not say that this is the only source of such depraved appetite. It may also be engendered by the opposite extreme of excessive luxurious pandering to general sensuality.

The practical inference suggested by this experience and these observations is, that speech-making, pledge-signing, and blue-ribbon missions can only effect temporary results unless supplemented by satisfying the natural appetite of hungry people by supplies of food that is not only nutritious, but savoury and *varied*. Such food need be no more expensive than that which is commonly eaten by the poorest of Englishmen, but it must be far better cooked.

Comparing the domestic economy of the poorer classes of our countrymen with that of the corresponding classes in France and Italy (with both of which I am well acquainted), I find that the raw material of the dietary of the French and Italians is inferior to that of the English, but a far better result is obtained by better cookery. The Italian peasantry are better fed than the French. In the poor osterias above referred to, not only the Friday salt fish, but all the other viands were incomparably better cooked than in corresponding places in England, and the variety was greater than is common in many middle-class houses. The ordinary supper of the "roughs" above-named was of three courses, first a "*minestra*," *i.e.*, a soup of some kind, continually varied, or a savoury dish of maccaroni; then a ragout or savoury stew of vegetables and meat, followed by an excellent salad; the beverage a flask of thin but genuine wine. When I come to the subject of cheese, I will describe their mode of cooking and using it.

My first walk through Italy extended from the Alps to Naples, and from Messina to Syracuse. I thus spent nearly a year in Italy during a season of great abundance, and never saw a drunken Italian. A few years after this I walked through a part of Lombardy, and found the little osterias as bad as English beershops or low public-houses. It was a period of scarcity and trouble, "the three plagues," as they called them—the potato disease, the silkworm fungus, and the grape disease—had brought about general privation. There was no wine at all; potato spirit and coarse beer had taken its place. Monotonous "polenta," a sort of paste or porridge made from Indian corn meal, to which they give the contemptuous name of "miserabile," was then the general food, and much drunkenness was the natural consequence.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

(*Continued from page* 138).

THE EVOLUTION OF CONDUCT.

Chapter III.

BUT within a race and in the relations of the race to other races, there are causes which influence the evolution of conduct. Members of a race fight out the contest for existence not alone but more or less in the presence of their fellows and in the presence of members of other races. Each individual in providing for his own wants or for his own defence affects more or less others, either of his own race or of other races, in their efforts to defend or sustain *their* lives. Very often, as Mr. Herbert Spencer quaintly puts it, "a successful adjustment by one creature involves an unsuccessful adjustment made by another creature, either of the same kind or of a different kind." The lion and the lamb, for instance, already anticipate the millennium; but the lion adjusts matters so much more successfully than the lamb, as to take the outside place; the lamb lies down with the lion, but—inside. Among all races, herbivorous as well as carnivorous, similar relations exist. The more vigorous get the better food, food which the weaker contend for in vain or have to resign, when obtained, to superior strength. Within one and the same race there is still the same law. The stronger monopolise, if they can, the feeding grounds of the race. The weaker, whether originally so, or become so through age or disease, succumb in greater numbers than the stronger in the struggle for existence. Only, while the death of those weak through age does not affect the evolution of the race, the greater mortality among those originally weaker than the rest modifies the race qualities.

In these contests conduct plays an important part. Unnecessary contests involve unnecessary risks. That conduct must prevail best in the long run, and therefore that conduct must eventually be evolved and developed, by which adjustments for the advantage of one creature do not needlessly interfere with adjustments for the advantage of other creatures. If we imagine a carnivorous animal carefully limiting his search for animal food to his requirements, not killing where there was no occasion, and keeping carefully all food he had once obtained, we see that his chances in the life struggle would

be better than those of a carnivore of the same race who killed whenever he got the chance. It would be more the interest of other creatures (as for instance those who wanted the same sort of food) to eliminate the carnivore of the latter sort, than to remove the more prudent member of the race. In the long run this would tell even among the lower animals. But as we approach the relations of men to men and men to animals, we see more obviously how conduct in which the interests or the wants of others are considered is safer in the long run, more conducive (in hundreds of ways more or less complex) to prolonged existence, than conduct in which those interests and wants are neglected. Hence there will be a tendency, acting slowly but surely, to the evolution of conduct of the former kind. More of those whose conduct is of that character, or approaches that character, will survive in each generation, than of those whose conduct is of an opposite character. The difference may be slight, and therefore the effect in a single generation, or even in several, may also be slight; but in the long run the law must tell. Conduct of the sort least advantageous will tend to die out, because those showing it will have relatively inferior life chances.

Mr. Spencer seems to me to leave his argument a little incomplete just here. For though he shows that conduct avoiding harm to others, in all races, must tend to make the totality of life larger, this in reality is insufficient. He is dealing with the evolution of conduct. Now, to take a concrete example, those of the hawk tribe who left little birds alone, except when they had no other way to keep themselves alive but by capturing and killing them, would help to increase the totality of life, by leaving more birds to propagate their kind than would be left if a more wholesale slaughter were carried out. But this of itself would not tend to develop that moderation of hawk character which we have imagined. The creatures helped in the life struggle would not be the hawks (so far as this particular increase in the totality of life was concerned) but the small birds; and the only kind of moderation or considerateness encouraged would be shown in a lessening of that extreme diffidence, that desire to withdraw themselves wholly from hawk society, which we recognise among small birds. But if it be shown that the more wildly rapacious hawks stand a greater chance of being destroyed than those of a more moderate character, then we see that such moderation and steadiness of character is likely to be developed and finally established as a characteristic of the more enduring races of hawks. And similarly in other such cases.

It is, however, in the development of conduct in the higher races only, that this comparatively elaborate law of evolution is clearly recognised. Among savage races we still see apparent exceptions to the operation of the rule. Individuals and classes and races distinguished by ferocity and utter disregard of the "adjustments" of others, whether of their own race or of different races, seem to thrive well enough, better even than the more moderate and considerate. Forces really are at work tending to eliminate the more violent and greedy; but they are not obvious. As society advances, however, even this seeming success of the rapacious is found to diminish, though as yet there has been no race or society from which it has been actually eliminated. Conduct which is imperfect, conduct characterised by antagonisms between groups and antagonisms between members of the same group, tends to be more and more reduced in amount, by the failure or by the elimination of those who exhibit such conduct. What is regarded as gallant daring in one generation is scorned as ferocity in a later one, resisted as rapacious wrong-doing yet later, and later still is eliminated either by death or nearly as effectually (when indirect as well as direct consequences are considered) by imprisonment.*

As violence dies out, and as war diminishes,—which usually is but violence manifested on a larger scale,—the kind of conduct towards which processes of evolution appear to tend, "that perfect adjustment of acts to ends in maintaining individual life and rearing new individuals, which is effected by each without hindering others from effecting like perfect adjustments," will be approached. How nearly it will ever be attained by any human race—*Quien sabe?*

One further consideration, and we have done with the evolution of conduct, the right understanding of which is essential to the scientific study of conduct. The members of a society while attending to adjustments necessary for their wants or interests, may not merely leave others free to make their adjustments also, but may help them in so doing. It is very obvious that conduct thus directed must tend to be developed. As Mr. Spencer says, such conduct facilitates the making of adjustments by each and so increases the totality of the adjustments made and serves to render the live of all more complete. But besides this (as he should also have shown, since it is an essential part of the evolution argument), it tends to its own increase: for, being essentially mutual, conduct of this kind is a favourable factor in the life struggle.

We have next to consider what, seeing thus the laws according to which conduct is evolved, we are to regard as good conduct and bad conduct.

(To be continued.)

"The world embraces not only a Newton, but a Shakespeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these but in all, is human nature whole. They are not opposed, but reconcilable—not mutually exclusive, but supplementary."—John Tyndall.

"When the Hebrew prophet declared that 'by him were laid the foundations of the deep,' but reminded us, 'Who by searching can find him out?' he meant pretty much what Mr. Spencer means when he speaks of a power that is inscrutable in itself, yet is revealed from moment to moment in every throb of the mighty rhythmic life of the universe."—John Fiske.

"Joyfully accepting modern science, and loyally following it without the slightest hesitation, there remains ever recognised still a higher flight, a higher fact, the eternal soul of man, (of all else, too,) the spiritual, the religious, which is to be the greatest office of scientism, in my opinion, and of future poetry also, to free from fables, crudities and superstitions, and launch forth in renewed faith and scope a hundred-fold. . . . To me the crown of savantism is to be, that it surely opens the way for a more splendid theology and for ampler and diviner songs." Walt Whitman.

The Tricycle.—The article on "High Wheels *v.* Low Wheels" referred to by Mr. John Browning in this week's Knowledge appeared in No. 8, Vol. II., of G. L. Hillier's Journal.

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* Many overlook the bearing of imprisonment on the evolution of conduct,—its influence (when long terms are considered) in diminishing the numerical increase of particular types of character and therefore in diminishing the quantity of particular forms of conduct.

EVOLUTION OF HUMAN PHYSIOGNOMY.

By E. D. Cope.

(*Continued from page* 137.)

IF we now examine the leading characters of the physiognomy of three of the principal human sub-species, the Negro, the Mongolian, and the Indo-European, we can readily observe that it is in the two first-named that there is a predominance of the quadrumanous features which are retarded in man; and that the embryonic characters which predominate are those in which man is accelerated. In race description the prominence of the edges of the jaws is called prognathism (forward jaws), and its absence orthognathism (straight jaws). The significance of the two lower race characters as compared with those of the Indo-European, is as follows:—

Negro.—Hair crisp (a special character), short (quadrumanous acceleration); prognathous (quadrum. accel.); nose flat, without bridge (quadrum. retard.)*; malar bones prominent (quadrum. accel.); beard short (quadrum. retard.); arms longer (quadrum. accel.); extensor muscles of legs small (quadrum. retard.).

Fig. 5.—Profile of a Luchatze negro woman, showing deficient bridge of nose and chin, and elongate facial region and prognathism.

Mongolian.—Hair straight, long (accel.); jaws prognathous (quadrum. accel.); nose flat or prominent with or without bridge; malar bones prominent (quadrum accel.); beard none (embryonic); arms shorter (retard.); extensor muscles of leg smaller (quad. retard.).

Indo-European.—Hair long (accel.); jaws orthognathous (embryonic retard.); nose (generally) prominent with bridge (accel.); malar bones reduced (retard.); beard long (accel.); arms shorter (retard.); extensor muscles of the leg large (accel.).

The Indo-European race is then the highest by virtue of the accelleration of growth in the development of the muscles by which the body is maintained in the erect position (extensors of the leg), and in those important elements of beauty, a well-developed nose and beard. It is also superior in those points in which it is more embryonic than the other races, viz., the want of prominence of the jaws and cheek-bones, since these are associated with a greater prominence of the cerebral part of the skull, increased size of cerebral hemispheres, and greater intellectual power.

A comparison between the two sexes of the Indo-Europeans expresses their physical and mental relations in a definite way. I select the sexes of the most civilised races, since it is in these, according to Broca and Topinard, that the sex characters are most pronounced. They may be contrasted as follows. The numbers are those of the list on page 136 already used. I first consider those which are used in the tables of embryonic, quadrumanous, and race characters:—

	Male.	Female.
	I. The General Form.	
2.	Shoulders square.	Shoulders sloped.
4.	Waist less constricted.	Waist more constricted.
5.	Hips narrower.	Hips wider.
6.	Legs longer.	Legs shorter.
8.	Muscles larger.	Muscles smaller.
	II. The Integuments, etc.	
10.	More hair on body, that of head shorter; beard.	Less hair on body, that of head longer; no beard.
12.	Skin rougher (generally).	Skin smoother.
	III. The Head and Face.	
16.	Superciliary ridges more prominent.	Superciliary ridges low.
22.	Eyes often smaller.	Eyes often larger.

Fig. 6.—Face of another negro, showing flat nose, less prognathism and larger cerebral region. From Serpa Pinto.

The characters in which the male is most like the infant are two, viz., the narrow hips and short hair. Those in which the female is most embryonic are five, viz., the shorter legs, smaller muscles, absence of beard, low superciliary ridges, and frequently larger eyes. To these may be added two others not mentioned in the above lists; these are (1) the high-pitched voice, which never falls an octave as does that of the male; and (2) the structure of the generative organs, which in all mammalia more nearly resemble the embryo and the lower vertebrata in the female than in the male. Nevertheless, as Bischoff has pointed out, one of the most important distinctions between man and the apes is to be found in the external reproductive organs of the female.

From the preceding rapid sketch the reader will be able to explain the meaning of most of the peculiarities of face and form which we meet with. Many persons possess at least one quadrumanous or embryonic character. The strongly convex upper lip frequently seen among the lower classes of the Irish is a modified quadrumanous character. Many people, especially those of the Sclavic races, have more or less embryonic noses. A retreating chin is a

* In the Bochimans, the flat nasal bones are coössified with the adjacent elements, as in the apes (Thulié).

marked monkey character. Shortness of stature is mostly due to shortness of the femur, or thigh; the inequalties of people sitting are much less than those of people standing. A short femur is embryonic; so is a very large head. The faces of some people are always partially embryonic, in having a short face and light lower jaw. Such faces are still more embryonic when the forehead and eyes are protuberant. Retardation of this kind is frequently seen in

Fig. 7.—Esequibo Indian women, showing the following peculiarities: deficient bridge of nose, prognathism, no waist, and (the right-hand figure) deficiency of stature through short femur. From photographs by Endlich.

children, and less frequently in women. The length of the arms would appear to have grown less in comparatively recent times. Thus the humerus in most of the Greek statues, including the Apollo Belvidere, is longer than those of modern Europeans, according to a writer in the "Bulletin de la Société d'Anthropologie," of Paris, and resembles more nearly that of the modern Nubians than any other people. This is a quadrumanous condition. The miserably developed calves of many of the savages of Australia, Africa, and America, are well known. The fine swelling gastrocnemius and soleus muscles characterise the highest races, and are most remote from the slender shanks of the monkeys. The gluteus muscles developed in the lower races as well as in the higher, distinguish them well from the monkeys with their flat posterior outline.

Fig. 8.—Portrait of Satanta, a late chief of the Kiowas (from the Red River of Texas), from a photograph. The predominance of the facial region, and especially of the malar bones, and the absence of beard, are noteworthy.

Some of these features have a purely physical significance, but the majority of them are, as already remarked, intimately connected with the development of the mind, either as a cause or as a necessary coincidence.

TRICYCLES.

THE article in KNOWLEDGE (No. 96) from the able pen of Mr. Browning prompts me, a rider of some fifteen years' experience of both bicycle and tricycle, to address you a few remarks upon the same subject, as I fear that Mr. Browning's deductions have led him to enounce theories concerning tricycles which, if acted upon by the novice, will assuredly cause him to become disgusted with his first efforts.

Small wheels are a great mistake from every point of view, and it is far easier to propel a machine with 50-inch wheels geared down to, say, 42, than it would be to drive a machine of even less weight with 36-inch wheels.

It is absurd to talk of anyone being content with a speed of four or five miles an hour, as such a pace can only lead to the rider becoming disgusted with the affair altogether.

It is as easy to ride a machine with large wheels at the rate of seven or eight miles an hour as it would be to ride one with 36-inch wheels at the rate of four miles an hour; nay, easier.

A man perched upon a machine with such small wheels looks as if riding a child's go-cart, and is hailed with derision by the drivers of carts, who are much more likely to give way to a machine that they can see is a vehicle than

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to take any note of a thing that creeps along at the rate of four miles an hour and has toy wheels.

To a rider of even average strength there are very few hills that need be walked, and those only the very steep ones, and it is a mistake to inculcate the impression that one mile in ten has to be walked. I have a great regard for Mr. Browning, but feel compelled to endeavour to set aside such fallacies as this, as I think they must serve as a deterrent to would-be cyclists.

The fact that Mr. Browning finds this to be the case is in itself enough to condemn the type of machine he advocates, as it is certainly not my experience, nor is it the experience of anyone I know, neither will it be the experience of anyone who possesses even an ordinary amount of strength.

I know an aged clergyman, very nervous and very feeble. When he first commenced to ride, he, of course, found it rather trying to ride the steepish hills in the north of London, but now he goes on his way, and very seldom walks up any but the very steepest of hills.

Anyone who wishes to begin to ride a tricycle will inevitably ere long strive to improve his pace, no matter how meek his preliminary aspirations may be; but if he starts with a very small wheel he will never be able to improve his speed, but will be a perpetual snail along the road until he goes to the further expense of a new machine. If, on the other hand, he at the outset goes in for a machine that will travel fast at pleasure, he can ride it as fast as he pleases or as slow as he pleases.

It follows as a mere matter of course that a machine that can be driven at a very high rate of speed must from that very fact be an easy running machine, as otherwise it could not be driven at a fast speed. Therefore, this is the machine to select, and while going slowly the utmost ease of propulsion is existent; and it is, at the same time, always possible to improve the speed as experience is gained.

To recapitulate, a fast machine must *ipso facto* be an easy machine to propel.

I fully endorse Mr. Browning's view as to lightness, as I have always urged this as a *sine quâ non—i.e.*, for a not too heavy rider, and I myself ride an Imperial Club which weighs under 60 lb., and yet it has 50 in. wheels. This machine is geared up to a 60 in., and still I ride all the hills I come to, seldom or ever dismounting; and I have several times ridden nearly, and even over, 100 miles a day. This machine is as easy to drive and as fast as a bicycle, and I can always hold my own on the road with anything, and yet when simply riding slowly I can move along with the slightest possible exertion.

Nothing wearies so much as rapid pedalling, and nothing looks so ungraceful; and it is obvious that with small wheels the pedalling must be very rapid indeed to get any pace at all. With my machine, however, my feet pass very slowly round and round, and still the gearing up (which, of course, consists in having the lower chain wheel larger than the top one; so that the wheels go round faster than the feet and the pedals) always keeps up a fair pace, and this is attained without fast pedalling.

The machine that I am sure will give the best result will be one weighing little, and that has wheels no less than 48 in. in diameter, and if this be fitted with the recently-perfected "speed-gear," either a fast speed or a low speed can be used for the level or for mounting hills, as the case may be.

I fear that I have already trespassed too far upon your space, but there are several other points which might have been dilated upon for the advantage of your readers, many of whom are absolutely certain to "go in" for tricycles when they realise how extremely useful they may be made for exploring the country and for means of exercise.

Sigma.

WINDS AS PROJECTILES.

M. J. C. HOUZEAU, referring to observations on the formation of clouds made by MM. Lancaster and Tempel, and by Mr. R. T. Armstrong, communicates to *Ciel et Terre* an article on "The Nature of Wind." He remarks that although wind is air in movement, the movement cannot be likened to that of a liquid sheet of vast extent, nor to that of a vein of liquid, nor to that of the sea-waves. If the air flow were in vast continuous sheets, its pressure would only vary slightly and gradually over the area it acted upon. It would not exhibit abrupt changes and intermittences. The aspect of a field of wheat on which the wind blows suffices to show that the air neither moves as a sheet nor as a vein.

In squalls there is often complete repose between the blasts. On Nov. 11, 1878, M. Houzeau witnessed a remarkable instance of this about 200 kilomètres south of the Lizard. The puffs were of extreme violence, while in the intervals the air scarcely moved. These intermittences, although reminding him of waves bursting on a shore, could not be considered like them. Between two succeeding sea-waves there is no water; the hollow is filled with air; if it were occupied with the former fluid the intermittence would give place to continuous action. But between the wind blasts there is air, which is not carried on with them. M. Houzeau does not deny that there is often a general movement of translation of air, as a proper motion, or as the result of blasts dragging it with them; but the phenomenon appears to him to consist of the movements of detached masses, which, to give precision to the idea, he compares with projectiles traversing the general mass of the atmosphere. The limited area to which storm-action is often confined, bending some trees violently and not affecting their neighbours, shows that these aërial projectiles have little breadth. Another fact, he considers, points to the same conclusion, for, if when the wind is strong, its pressure per square mètre is observed on anemometers of different sizes, the larger ones show the highest proportional results. The greater the surface, the greater the chance of its receiving the shock of the projectiles. If there were no divisions in the air-streams, the pressure per square mètre would be independent of the dimensions of the anemometer plates.

The friction of air is so slight that there is nothing astonishing in the feeble entraining power of the projectiles. What is less easy to conceive is the nature of the force which impresses upon sharply-defined portions of air the furious velocities which sometimes animate them. But before attacking this question Mr. Houzeau advises studying what may be called the texture of the air in tempests, and to ascertain the number, dimensions, and relative spacing of these projectiles which traverse the atmosphere as a kind of *mitraille*.

If, as M. Houzeau states, it is a general fact in storms that large anemometers show a much greater average pressure than small ones, it is evident that calculations founded upon the velocities of the cups usually employed give no indication of the resisting power required to prevent a recurrence of such incidents as the Tay Bridge disaster. But M. Houzeau should indicate the experiments upon which he bases this statement, as exactly the opposite is affirmed by other persons.

DANGERS OF SEA-BATHING.

WE have recently had evidence of the three chief dangers of sea-bathing. First it was a case akin to the fatal bath of Alexander the Great, where death was caused by suddenly plunging the body, when hot and tired, into very cold water. Then came a case in which cramp affecting all the lower part of the body caused death. Lastly, at Eastbourne, on Sunday, August 26, a young man was drowned through bathing too soon after a full meal. It is singular how people underestimate the nature of the trial to which they expose their bodies in sea-bathing. The trial is indeed one which can be borne safely by any one in average health, under reasonable conditions. But even for the healthy it involves a shock, the reaction from which is what does good, not the shock itself, which so far as it goes tends to lower the vital energies. But to plunge into cold water when the vital energies are already below par, or under conditions which are likely to overtax the force of reaction is dangerous in the extreme. Another dangerous practice is that of staying in the water too long. To sea-bathing for the health Hesiod's old saying may be applied. Half is better than the whole, when the whole means the full time which the bather can stay in the water without suffering. If a man can bear twenty minutes in the water he will do well to take but ten; if he can bear ten, to take but five. When he stays in the water for the shorter period he comes forth braced up and invigorated; when he keeps in as long as he can bear the cold he comes out at last tired and wearied, feels depressed and languid for hours or perhaps for the rest of the day, and probably suffers from headache or other evidence that the nervous energies have been overtaxed.—*Newcastle Chronicle.*

Editorial Gossip.

It is hard when some quality—mental, moral, or physical—on the strength of which any one has come before the public—is specially criticised as the one quality in which such person is deficient. For instance, let us suppose that when Disraeli told his constituents that "he 'stood' on his head" some one had rudely remarked that that was his weakest place: this would have been as hard as it would have been untrue. So, if I were told in connection with my teachings in astronomy, that astronomy is just the subject in which I am most ignorant, I suppose I should not be greatly pleased: even if I were modest enough to admit the soft impeachment, I should be pained at the thought that my special ignorance on that subject had remained so long unknown to me. It occurs to me to note, by the way, that only a day or two since I came across a passage in the *Ottawa Free Press* from which I learned that Mr. Wiggins, the predictor of the famous storm which was to have destroyed every ship at sea last March, but somehow failed to do so, had pointed out so far back as 1876 my ignorance of astronomy. I had lectured at St. John's, N.B.,—I remember well that mild Christmas time (where I had expected intense cold, but walked from my lecture, in evening dress, with overcoat over my arm); and I remember too my kindly greeting there. I had said in the course of my lecture that the moon has very little if any atmosphere. But next day (when I was half way towards New York) Mr. Wiggins observed that as the moon reflects sunlight she must have an atmosphere of considerable density, and also showed how ignorant I must be not to know that. So he found out that when I slightly criticised his storm-prediction, casually referring to knavery or folly in explanation thereof—I had been lying in wait six or seven years to attack him. "All this time," he says "the Professor has lain in his lair"! &c. It will be seen that I know or ought to know how painful must be a charge of shortcoming in some quality where one had imagined oneself rather exceptionally well off. I can sympathise therefore with Mr. Oscar Wilde when a play of *his* is condemned for vulgarity and coarseness by the Americans whom he sought to soften and harmonise. And now more distressing news still comes from across the Atlantic. A person went over there not on the strength of head or understanding (other than legs and feet) but trusting to beauty of limb and charm of manner; and here is the *Courier Journal*, of Louisville, Ky., rejoicing that those hideous limbs and monstrous hands and feet are gone from out the land. But the Kentuckian—who usually sits on five chairs at once, so long is he of limb, and so expansive in manner—is unusually critical about feminine hands and feet. The ladies of Kentucky are singularly favoured by nature in that respect, insomuch that though the feet (for instance) of an average St. Louis lady would not be thought large in England it is a standing joke in Louisville, Ky. that St. Louis shoes sent to the Centennial Exhibition, were by a natural mistake placed in the canoe department. Still the Kentuckian paper has not been over-polite to our English visitor, who rather "stood" on her feet.

Mr. Romeike, whose "Artistic and Literary Correspondence" I am willing enough to advertise gratis, seems determined to show me that I ought to recognise the value of his agency for distributing press notices to those mentioned in them. I was hard-hearted enough to say that these were things to be avoided rather than sought. He suggested in reply that though I might receive numbers of ordinary notices from publishers, I might not see those which attacked me, and he implied that these were more numerous by far than I probably imagined. Now my own idea has been, and is, that that ancient institution (*vide* Job *passim*) the "d—d—*dear* good-natured friend," had long since anticipated Mr. Romeike's agency, and that I need not fear lest anything unpleasant about myself should fail to reach me. But Mr. Romeike thinks differently; so, though I had expressed no burning desire to see such notices, he has sent me all he has come across,—to wit, within the last six months *two* out of seven (all the seven having reached me earlier through the D. G. N.). The last he sends me is rather pleasant than otherwise, only Mr. Romeike carefully underlines (courteous gentleman that he is) the parts which he thinks likely to hurt. Here is the passage, as it appears in *Life*, except only that those words which the gentlemanly Mr. Romeike underlines for my benefit appear here in italics:—

"A paper on 'Poker Principles and Chance Laws,' by Mr. R. A. Proctor, whose right to discuss this topic, otherwise indisputable, would be fortified, in case it needed fortification, by his famous victory over 'Boss.' *Unhappily Mr. Proctor's numerous accomplishments do not include an accurate knowledge of his native tongue.* In this article, for instance, he talks of 'the *verbiage* of Poker' and of 'astrological *verbiage*,' where a more correct writer would have substituted the word 'terminology' or 'nomenclature,' or, more appropriately, if less elegantly, 'slang,' for that which we have italicised. Furthermore, to pass from mere verbal criticism to more important matters, it appears to us, though we say so with the utmost diffidence, that Mr. Proctor's statement on page 503, to the effect that the odds against the throwing of 'size' after five 'sizes' have been already thrown, are only five to one, involves *a gross fallacy.* True, to any one ignorant of the preceding throws, the odds against 'size,' or any particular number, turning up are five to one. But to any one who knows that 'size' has already

been thrown five times running—and this is the very case with which Mr. Proctor is dealing—the odds against 'size' recurring on the sixth cast are not five to one, but forty-six thousand six hundred and fifty-six to one. This is so bold a challenge of Mr. Proctor's accuracy that we hasten to shelter ourselves under the authority of John Stuart Mill, in whose 'Logic' (Vol. II., page 75, 7th edition) the principle for which we are contending is laid down. For the rest, Mr. Proctor's article is well worth reading; all the more, on account of the high moral tone which pervades it."

Well, the only fault here is that the critic, whom I suppose to be a little inexperienced, generalises from a single observation, asserting general inaccuracy on the strength of a single slip (as he supposes my use of the word "verbiage" to be). As to this word, which was first used (and invented) by Samuel Johnson, it is commonly defined, I know, as meaning merely "wordiness." Johnson himself did not use it in that sense. If he had meant "wordiness" he would have used the older word "verbosity." My critic evidently thinks "verbosity" and "verbiage" the same, as many do who ought to know better—some dictionary-makers to wit. I prefer to use the word as a more convenient form than "terminology" or "nomenclature." Besides it chanced (a mere detail) that I did not *mean* terminology or nomenclature. "Slang" would not have suited me at all. A word so recently introduced into our language as "verbiage" is not quite so definitely fixed in meaning as my critic imagines, nor to be too readily made identical with another much older word ("verbosity") the existence of which is enough to show that "verbiage" as used by Johnson (who knew all about verbosity) had a different significance.

As for the "gross fallacy,"—if John Stuart Mill has in his "Logic" said that the chance of throwing "size" after "size" has been, and is known to have been, already thrown five times running, is 46,656 to 1, that would only illustrate the fact, already known, that Mill's mathematical conceptions were inexact. The odds are not even 46,656 to 1, but 46,655 to 1 against throwing "size" six times running. But to make the odds the same against throwing a sixth "size" after five already thrown, as they are against throwing "size" six times running, would be so gross and palpable a blunder, that I cannot imagine Mill ever imagined it. It is hardly necessary for me to point out that my own statement simply presents the truth as known to every mathematician. But I think I can make the fallacy attributed to Mr. Mill quite clear to my critic. Suppose, in coin-tossing, "head" tossed three times running. According to the view I have presented, the chance of tossing a fourth "head" is simply one half, or the odds for and against are even (1 to 1). According to the view attributed to Mill, as four heads come in succession in only one case out of 16 possible cases, the chance is 1-16, or (making the same confusion between the chance and the odds), my critic would write that the odds are 16 to 1 (instead of 15 to 1, as they would be if the chance is 1 in 16). But half-an-hour's steady tossing will soon convince my critic in *Life* that this is not the case. He will get, perhaps, fifty or sixty cases in which heads or tails come three times at least in succession, and he will find that in about half (*not in about a sixteenth*) of these cases head or tail, as the case may be, is tossed a fourth time. If he would lay a wager of £15 to £1, after every case in which three heads or three tails had appeared, that the fourth tossing would *not* be of the same kind as the three, his opponent would very soon be able to say of the problem—as my critic retreated from before him with empty pockets—*Solvitur ambulando!*

But my critic in *Life* speaks with becoming modesty on a subject which—as he seems to admit—he has not very carefully studied. Where we chiefly differ is in this,—I *have* carefully studied it.

As regards "accurate knowledge of my native tongue" (a most inaccurate expression, by the way), I think I may say to my not unkindly critic,—

> Teach not a parent's parent to extract
> The embryo juices of an egg by suction;
> The good old lady can the feat enact
> Quite irrespective of your kind instruction.

THE FACE OF THE SKY.

From Sept. 14 to Sept. 28.

By F.R.A.S.

The student will continue to watch the Sun daily for signs of disturbance. Splendid faculæ appear now at intervals on the solar limb. The face of the stellar vault will be found delineated on Map IX. of "The Stars in their Seasons." Mercury is an evening star, but is very close indeed to the horizon at sunset. As Venus comes into superior conjunction with the Sun on the 20th (in other words, is behind him), it is needless to say that she will be invisible during the next fourteen days. Mars rises soon after 11 o'clock at night on the 14th, and between 10 and 11 p.m. by the 28th, half-way between the N.E. and the N.E. by E. points of the horizon. His diameter is slowly increasing, but little or no detail can as yet be made out upon his suface with the telescope. Jupiter rises at half-past 12 o'clock at night on the 14th, and before midnight by the end of September. His path lies in Cancer during our specified period. No fairly observable phenomenon of his satellites occurs during the ordinary working hours of the student's night. Although Saturn is on the meridian during the early morning, yet he rises about 9 h. 7 m. p.m. on the 14th, and soon after 8 h. in the evening of the 28th. With his rings approaching their greatest opening, the planet now presents a spectacle of the highest interest to the observer with the telescope; and is coming into a more favourable position every night. He is above and a little to the left of Aldebaran. Uranus, like Venus, is behind the sun, and, of course, invisible. Neptune in a barren point of Aries is indistinguishable from a telescopic star. The moon is 12·9 days old at noon on September 14, and, quite obviously, 26·9 days old at the same hour on the 28th. The full moon of the 16th is the so-called "Harvest Moon." After the 23rd, she rises too late for the ordinary amateur observer. Occultations of stars by the moon are rather more numerous during the next fortnight. Of those which occur not much later than midnight we may mention that of c^1 Capricorni, a 4½ mag. star, which will disappear at 8h. 44m. p.m. on September 14, at the moon's dark limb, at an angle from her vertex of 171°; reappearing at her bright limb, at a vertical angle of 208°, at 9h. 5m. p.m. On the same night c^2 Capricorni, a 6th mag. star, will disappear at the dark limb at 8h. 47m. at a vertical angle of 91°; and reappear at the bright limb of the moon at 10h. p.m., at an angle of 300° from her vertex. Passing over occultations which happen at 3h. 4m. and 5 a.m., we come to one of the 6th mag. star B.A.C. 1,119 which on the night of the 20th will disappear at the moon's bright limb at 11h. 47m. at an angle of 7 from her vertex to reappear at the dark limb, at an angle from the vertex of 308°, 20 minutes after midnight. Before the moon rises on the 22nd she will have occulted 120 Tauri, a 6th mag. star. Subsequently this will reappear from behind her dark limb at 10h. 19 m. p.m. at an angle of 239° from her vertex. Lastly, on the 24th, 27 minutes after midnight, 68 Geminorum, a star of the 5½ magnitude, will disappear at the bright limb of the moon, at an angle of 30° from her vertex, to reappear at her dark limb at a vertical angle of 243° at 1 h. 19 m. the next morning. The moon occupies all to-day and a great deal of to-morrow in traversing Aquarius, passing into Pisces about 5 a.m. on Sunday, the 16th. It is 4 a.m. on the 19th before she has performed her path across this great constellation and entered Aries. She travels across Aries until 7 p.m. on the 20th, when she passes into the confines of Taurus, her passage across which takes until 6 a.m. on the 23rd. At this hour she enters the northern boundary of Orion, which she occupies twelve hours in crossing, emerging into Gemini about 6 p.m. At noon on the 25th she enters Cancer, which she quits for Leo between 5 and 6 o'clock in the morning on the 27th. At midnight on that day she descends into Sextans. We there leave her.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

THE BENNETT BATTERY.

[924]—My attention has been called to a paragraph in your issue of Sept. 1st, which contains several grave misstatements in connection with the voltaic battery which bears my name. You are, of course, at liberty to publish the results of honest experiments made with the battery, and to remark thereon in an impartial spirit, but you are not entitled to publish distinct untruths, with the apparent object of injuring it in public estimation. Your contributor states that the battery gives forth an odour of rotten eggs to such an extent as to contaminate the air, and attributes the smell to sulphuretted hydrogen (!) As a matter of fact, the battery is *quite* odourless, and cannot, under any circumstances, emit sulphuretted hydrogen, for the very sufficient reason that there is no sulphur in any form in the cell. Your contributor states that the cell is of no use whatever to anybody. Perhaps you are unaware of the fact that it is in extensive use in Scotland and elsewhere for several purposes, and is giving better results than the Leclanché. An exhaustive comparative trial has been in progress, on a practical scale, since March last, by independent persons in Glasgow, with the result, so far, altogether in favour of my battery as compared with the Leclanché. These results, in a tabulated form, are to be published on the completion of the experiment, which has been prolonged owing to the durability of the battery. The bias of your contributor is evident from the fact that he makes an equally untrue statement regarding the Leclanché battery. He states that, even with hard work, the agglomerate blocks last two years. All practical men know this to be false. With such work as they get in the Glasgow Central Telephone Exchange, agglomerate blocks last from three to four months, and then require complete renewal.

Sept. 5, 1883. A. R. BENNETT.

[My remarks on the Bennett cell were based on experiments made upon it some months since. The odour of SH_2 was unmistakable, and I attributed it to the presence of impurities. The cell did not show such good results as were obtainable from the six-rod agglomerate Leclanché, and I could not, therefore, recommend amateurs to adopt the cell. Practical men would judge for themselves. May be the invention of Mr. Bennett has been lately improved. If so, I shall be glad to hear from him, and he will find that no journal is more ready to bestow praise where it is deserved than KNOWLEDGE. Anent the durability of the agglomerate, all practical telegraph men praise it highly for what it has done and is still doing. I could have shown Mr. Bennett a number of blocks which had been working hard, night and day, for upwards of eighteen months. The resistance of a telephone line is very low in comparison with the average telegraph line, and that may help to account for the bad result Mr. Bennett has obtained. Or it may be that he has had a large number of short circuits drawing upon one battery at a time.—W. SLINGO.]

SMALL WHEELS FOR TRICYCLES.

[925]—I am obliged for the reminder of your correspondent "J. S." that the "Sun and Planet" is a small-wheeled bicycle geared-up. I have seen the machine, though I have never ridden it as I have the "Facile." If the merits of the machine are great, it is a pity it is not more advertised, as, being a rotary machine, some would prefer it to any machine with a lever action.

As "J. S." suggests, there may be a great future for small geared-up safety bicycles. Will "J. S." oblige me by stating the true weight, of his own knowledge, of his machine?

I am glad that so thoughtful a rider agrees with my conclusions as to the desirability of reducing the size of the wheels of tricycles. Since my papers on this subject have appeared in KNOWLEDGE, I have received assurances from the following well-known riders that they agree with my conclusions:—Messrs. Marriott, Nixon, Letchford, S. Salmon, A. Salmon, and Howard, and also Messrs. Grace and Bennett. It must be recollected that all these riders have tried first large wheels and then small, and have *proved* small to be the best. JOHN BROWNING.

A CURIOUS PHENOMENON.

[926]—Can any of my brother readers of KNOWLEDGE offer a feasible explanation of a very remarkable phenomenon which I witnessed at 10h. 35m. p.m. on Tuesday, August 28? I was just coming out of my observatory when, on the E.N.E. point of the horizon beneath the Pleiades, I saw a bright light. My first thought was that the moon was rising, but an instant's reflection sufficed to remind me that she would not be up for the next two hours. As I watched the light becoming brighter and brighter, I saw that it threw a kind of radial illumination upward, the effect of which I have tried to reproduce in the accompanying rough little sketch.

As will be seen, a few distant cumulo-stratus clouds, close to the horizon, crossed it. For a moment I imagined that I was viewing the apparition of a new and most glorious comet; but, as I watched, the "tail" disappeared. and what would represent the nucleus flashed up brilliantly. Then I made up my mind that some distant house, barn, or haystack was on fire, and returned to the observatory for a 3-inch telescope, which I keep for looking over the landscape. Before I had time, however, to enter the door, every vestige of illumination disappeared as suddenly as it had come into view, and after waiting in vain for some time, I left the observatory and came into the house. I have diligently inquired if there was a fire anywhere in this part of Sussex on the night of which I am speaking, but there was none. Were the Crystal Palace concealed by the high ridge from behind which this strange apparition arose, the concluding burst of a grand pyrotechnic display might reproduce what I witnessed; but merely as a matter of topography the Crystal Palace is not on Ashdown Forest, nor on Crowborough Common (which lies beyond it in an E.N.E. direction from here) either. Nor, oddly enough, does any house, or even any agricultural buildings, lie upon the line drawn from my observatory through the point at which this light arose, as any one may see from the Ordnance Map, whereon, of course, Forest Lodge is marked. I may add that the latitude of the observatory is 51° 0′ 56″ N., and its longitude 17·8″ E. of Greenwich. WILLIAM NOBLE.

STORMY PETREL.

[927]—On going into the yard at the back of 13, Guildford-street, Birmingham, about 7.30 a.m. on Sept. 4, I saw a strange bird lying with wings extended, quite dead, but warm. It had evidently dropped from exhaustion. On examination it turned out to be the stormy petrel (*Procellaria pelagica*). I attribute it to the very heavy gales that have occurred lately. You may insert this if you think it will be of interest to any of your readers of KNOWLEDGE.

R. W. BURFORD.

XUM

THE COMMA.

[928]—I send you an example of a printer's comma which may interest you: Matthew xxvii. 23, "Why, what evil hath he done?" The original reads, *τί γὰρ κακὸν ἐποίησεν*. The printer's comma makes a double question and causes the "why" to refer to "Let him be crucified." It is so read by ninety-nine out of a hundred. I trouble you with this, because I believe it is not generally known, and it appears interesting to me. A. H. Tate White.

A RABBIT'S SKULL.

[929]—I see you have an article in Knowledge of Aug. 17, on "A Rabbit's Skull." I may here mention that my father has in his possession a skull very similar to that spoken of, but still more interesting, as in this case the top *right* incisor, which is quite three inches in length, has grown right up through the roof of the mouth on the *left* side, and passing down once more, ends just where it began. The one in the lower jaw is an inch and a half long, and has grown out almost straight from the mouth. There appear to be two incisors in the top jaw, but only one in the lower, and, although it was impossible for the front teeth to close, yet the rabbit seemed in perfect health, and was in good condition when shot.

Leila C.

LIGHT FROM FLOWERS.

[930]—The following extracts from a book entitled "Lessons in Physical Science" (Simpkin, Marshall, & Co., 1872) may meet the wishes of your correspondent (882) on the above subject. They may be found in the chapter commencing at page 151:—

"The spark elicited by stroking the back of a cat, or by the action of an electrical machine, does not differ in its nature from the lightning which flashes from the storm-cloud, nor from the brilliant and variegated auroras which stream through the upper regions of the atmosphere in Polar latitudes, and which, to some extent, compensate, in those dismal abodes of winter, the long absence of the solar beams. To the same source—electricity—we probaby owe the light which, at certain seasons, and at certain times of the day, issues from a number of yellow or orange-coloured flowers, such as the marigold, the sunflower, and the orange-lily. The daughter of Linnæus, the great naturalist, is said to have first observed these sparks and flashes playing about garden flowers during the summer twilight of 1762, but similar phenomena have been witnessed by several naturalists. Flashes, more or less brilliant, have been seen to dart in rapid succession from the same flower. At other times the tiny flame-jets have followed one another at intervals of several minutes. . . . Sir H. Marsh gives an account of a female about whose head strange luminous appearances were observed. Shortly before her death several attendants saw a pale bluish light, like that of the moon, proceed from her head; and Professor Donovan witnessed, in the case of a man in the later stages of consumption, mysterious lights, once in the form of a luminous fog, resembling the aurora borealis, and twice in the form of scintillations like the sparkling phosphorescence exhibited by sea infusoria."

A similar instance is given in "Notes and Queries" of Aug. 25, page 158, under the heading of "The Nimbus." G. M.

GINGER-BEER PLANT.

[931]—In reply to Mr. F. H. Perry's query, the following information from my own observation may prove useful. The fungus he mentions is precisely similar to yeast in its action on a solution of sugar and water. The process of making "ginger-beer" may be carried on very well without the "ginger," but if the sweet solution is left too long it becomes vinegar.

Mr. Perry has, I think, been slightly misinformed concerning the nature of the so-called "ginger-beer plant." It can only live and propagate in a saccharine fluid. F. W. Halfpenny.

COFFEE.

[932]—Would you be kind enough to ask Mr. M. Williams to give a receipt for mixing or flavouring coffee with burnt sugar, as lately described by him in his papers on "Scientific Cookery" in Knowledge?

The papers are very interesting, and having long wished to get a hint as to obtaining coffee *at home* as we get it at Gatti's restaurant, I felt disappointed that the paper in question did not give a fuller account of it, viz., of quantities and proportions required of each for mixing. If Mr. Williams would oblige with these particulars, no doubt they would be very acceptable to many other readers of Knowledge. W. G. Mortimer.

OPTICAL PHENOMENON.

[933]—The following account of a phenomenon which came under the notice of a friend and myself the other day on one of the Cumberland mountains, may be of interest to the readers of Knowledge, as it is, I believe, of rather rare occurrence.

The mountain in question was Great Gable, one of the highest in the Lake district. We ascended it on Aug. 23 last, being on the summit between 6 and 7 p.m. The day had been very hot and fine, and the light evening clouds were floating on the tops and sides of Great Gable and the surrounding heights. One of these clouds was just passing off when we suddenly saw our shadows (or reflections) on the receding mist, with a double rainbow round both. They gave us the impression of being perhaps 100 to 200 yards away, and 10 or 15 feet in height. The rainbow was of small radius and very bright.

This appearance lasted about two minutes, as far as I can judge, coming on for a short time a minute or two afterwards. The clouds were moving in a direction from the sun, and we were, of course, in a line with the sun and our spectres. The outline of the figures was very sharp and distinct, and answered to our movements. G. G.

LETTERS RECEIVED AND SHORT ANSWERS.

Mr. H. Phillips.—The paragraph was taken from a highly-respected contemporary. The fact of the praise bestowed on the lamp being inserted demonstrates the absence of an inimical spirit. In fact, you can rest assured that the reverse is actually the case. We insert a correction.—C. T. Parsons. You do not mention your telescope's size: a good deal depends on that.—D. E. Samuel. There are many ways of showing, or seeming to show, by algebra, that $1=2$. They mostly depend on the property that once nothing is equal to twice nothing. Thus, let $a=b$; then $a^2=b^2$, and $a^2-b^2=0=a-b$. Dividing by $a-b$, we have $a+b=1$. Now put $a=b=1$. Then our result is that $2=1$: which is absurd. Hence something in our process must be absurd. The place is soon found. We had $a^2-b^2=a-b$; that is, $(a+b)(a-b)=1(a-b)$. When $a=b$, $a-b=0$; so that this equation means that $2\times0=1\times0$, which is true enough. But dividing each side by 0 and making $2=1$, is manifestly an absurd process, leading to an absurd result. One might as well proceed thus:—A million times nothing equals twenty times nothing; therefore a million is equal to twenty.—T. J. Beardwell. Have you not made a slight mistake in your first problem? If the death rate is 21 per 1,000, and the births 25·0645 per 1,000, the *increase* per cent. is ·40645, not 2·50645 as you make it. Getting the population to double in 28 years would be a rather serious matter. Your formula is approximately true.—Thos. H. D. Evening time. The moon map referred to illustrated the first of F.R.A.S.'s papers on the Moon, in the beginning of Vol. 3. Have not the volume by me to refer to.—L. C. C. I could not let the author of articles "How to Get Strong" give advice under the circumstances. The case is one for most careful medical advice.—R. Donald. (1) Such lightning indicates usually the progress of a distant thunderstorm. Not seen in day because daylight hides it. (2) Minnows grow but (3) not into trout.—Chas. Wood. Perhaps some correspondent knows of a "black sympathetic ink, to act as the green one produced by dilute muriate of cobalt,—viz. to be invisible when applied on paper and by heat to be produced, and as it cools to vanish again."—H. T. B. See fortnightly "Face of Sky" in our columns.—D. King. Railway accident put my work back so that the subject has not been resumed, but it will be next week.—Several Correspondents point out that the quotation at the head of the last instalment of Mr. Kimber's account of anemones is incorrect. The alteration of the order of the lines was probably intentional; as suiting the application of the lines best; "fragrance" for "sweetness," is a frequent mistake. The lines escaped my attention.—J. F. Rounthwaite. I should certainly much like to visit Manitoba, when I return to America (1884, not 1885, I think); and you may be assured it would add greatly to my pleasure to meet an old Lady Somerset captain.—W. W. T. A good lunar chart (Mr. Webb's) appears in "Webb's Celestial Objects for Common Telescopes" and in my book on the Moon.—Uncertain. So am I. At least about the use of the words Natural and Supernatural. But I am certain you ought not to swear when you hear them. To answer your questions we ought to know much more than we do, or than we are ever likely to do.

The Pilsen Joel and General Electric Light Company (Limited).—A petition presented last month for winding up this Company was dismissed with costs. The petition was erroneously said to be presented by the Company, who, however, opposed it, and, as we see above, successfully.

Our Mathematical Column.

EASY LESSONS IN GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

(*Continued from page* 127.)

SUCH problems as I mentioned in my last, usually belong to a more advanced stage of study than that for which these simple papers are intended. They also often require the use of the Sixth Book. It will suffice here to consider a few of the simplest cases.

Suppose we have such a problem as this given:—

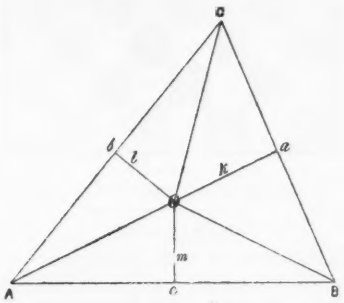


Fig. 34.

The sides of the triangle A B C (Fig. 34) *are bisected in the points* a, b, c, *and the three straight lines* a k, b l, *and* c m *are drawn at right angles to* B C, A C, *and* A B *respectively, show that these three straight lines,* a k, b l, *and* c m, *pass through a point.*

Here the student might at once refer to the Fourth Book, and find a proof in the circumstance that *a k* and *b l* have there been shown to meet at the centre of the circle through the points A, B, C. So also by the same book do the lines *a k* and *c m* meet at the centre of the circle through the points A, B, C. Now there is but one circle passing through these points; for if there were two, two circles would intersect in three points, which is impossible. Hence *a k*, *b l*, and *c m* pass through the same point.

But although this proof is sound enough, it is not independent, as a proof of this sort should be. Yet an actual and sufficient proof will run closely, as might be expected, in the lines followed in Book IV.

It is hardly necessary to say that the proof must be indirect. We can show, as in Book IV., that if *a k* and *b l* meet in O, the lines O A, O B, and O C are all equal. Then since A O = O B, a line from O perpendicular to A B must bisect A B, in other words, must pass through *c*, and coincide with *c m*. Hence if we wished to put the proof in Euclidean form, we might begin by saying,—If possible let *c m* not pass through the point O in which *a k* and *b l* intersect, but have some other position as *c m o*. Then after proving that A O = O B, we could show that O *c* is at right angles to A B. But *c m o* is at right angles to A B, wherefore from the same point *c*, there can be drawn two straight lines, at right angles to A B and on the same side of it,—which is impossible, since all right angles are equal. Therefore the line through *c* at right angles to A B cannot lie otherwise than through O.

In a similar way we can deal with the problem—

If the three angles of the triangle A B C (*Fig.* 35), *be bisected by the lines* A *a*, B *b*, *and* C *c these straight lines will all pass through one point.*

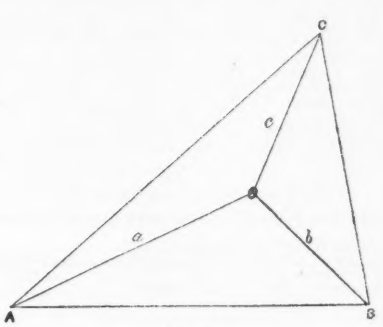


Fig. 35.

But now suppose we have this problem,—

From the angles A, B, *and* C, *of the triangle,* A B C, *Fig* 36, *lines are drawn at right angles to* B C, C A, *and* A B *respectively. These three straight lines shall all pass through one point.*

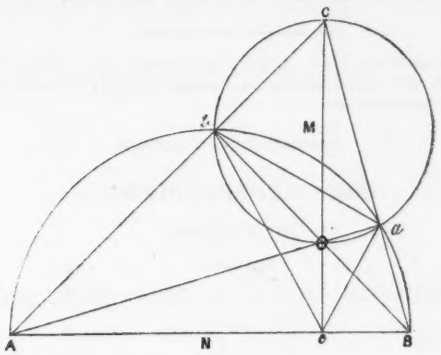


Fig. 36.

Here again the indirect method must be employed. We may draw A *a*, B *b*, at right angles to B C, C A respectively, and intersecting in O; then if we can prove that C O (produced if necessary) is at right angles to A B, what is required is done.

We have in this case the angles at *b* and *a* right angles; and it is nearly always well to try in such cases whether any good comes from noting that the angle in a semicircle is a right angle. This at once shows that a circle on O C as diameter will pass through *b a*; as will also a circle on A B as diameter. Suppose these circles drawn; or if any difficulty arises from the effort to *conceive* them as drawn, draw them in, as in the figure.

Also it will obviously be convenient to draw in the lines *a b*, *b c*, *c a*.

We have now to show that C O *c* is at right angles to A B. If this be so, the angles *c* C A and *c* A C together make up a right angle, or are complementary to each other. Of these the angle *c* A C is a known angle; so that if we look for an angle *known* to be complementary to *c* A C, we may be able to prove that so also is *c* C A. Now the angle A B *b* is complementary to *c* A C by the construction. Can we show that ∠ A B *b* = ∠ *c* C A? We must try our circles. We see that ∠ A B *b* = ∠ *b a* A on the same segment A *b*; and we see that ∠ *b a* A or *b a* O = ∠ *b* C O on the same segment *b* O. This clearly serves our purpose. For we have

∠ *b* C O = ∠ *b a* O = ∠ *b* B A = compt. of C A B

wherefore angle C *c* A is a right angle.

(*To be continued.*)

Our Whist Column.

By "Five of Clubs."

WHIST QUESTIONS.

RETURNING PARTNER'S SUIT.—"It hath been given out," "usually return your partner's lead, unless you have a good suit of your own." What am I to understand by a "*good suit*" to return? Suits that are considered good to lead from a hand next to the dealer are not always good suits to commence with, after having won your partner's trick. Can suits be called good that require more than two leads coming from a third hand to establish?

MUFF.

[Cavendish says, return only if you have a "very good suit." For my own part, I attach so much importance to knowing early where my partner's strength lies, that I should say to him, Show your own suit if it is anything above medium strength, besides of course being long.—FIVE OF CLUBS.

LONG WEAK SUITS.—Is there any use trying to establish a suit of Five, headed by a Ten, with three or four small trumps in the same hand? The greater number of gentlemen I have had for partners during the past twelve months have always led from their long suit, and what is most extraordinary, none of them have played the game less than "forty years."

MUFF.

[There can be no doubt they are right in so leading. The object

is not so much to establish the long suit, as to play a safe defensive game. Any other lead would be unsafe.—Five of Clubs.]

Signalling for Trumps.—(In reply to "Muff"), this is playing an unnecessarily high card,—as a seven first round, five second round.

*** Most of the back numbers of Knowledge in which Whist principles were explained can be obtained by applying to the Office in Great Queen-street.

Our Chess Column.

By Mephisto.

POSITION IN A GAME BETWEEN STEINITZ AND AN AMATEUR.

Amateur.

Black.

White.

Steinitz.

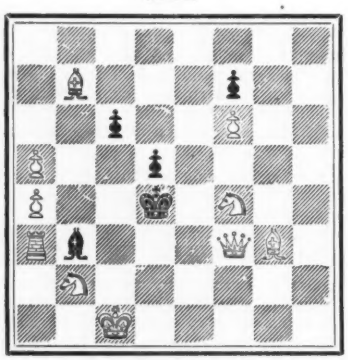
It was Black to move, and the game ended in the following pretty manner:—

	Kt takes P	B takes Kt	B takes B
B takes Q	Kt takes Q	R takes P (ch)	K takes R
Kt to K7 (ch)	K to R sq.	R to R sq. mate.	
RP takes Kt	QR takes B		

PROBLEM No. 97.

By C. Planck.

Black.



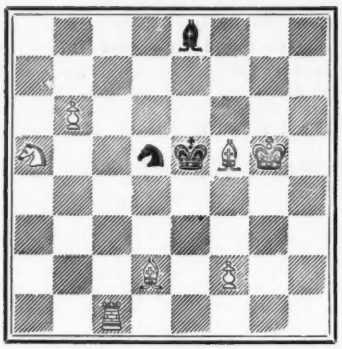
White.

White to play and mate in two moves.

PROBLEM No. 98.

By J. C. S.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Problem No. 94, by E. N. Frankenstein, p. 144.

1. Kt to Q3 (ch)	R takes R	4. Q to Kt2 (ch)	R takes Q
2. Q to Kt8 (ch)	Kt to K3	5. Kt to B4 (ch)	Kt tks Kt (ch)
3. B to R2 (ch)	R takes B	Mate.	

No. 95, by J. C. S., p. 114.

1. R to K8	Q takes R		Q to K7 (ch)
2. Kt to B6 (ch)	K to B5	R takes Q (ch)	K to B4
3. Q takes P (ch) mate.		Q to B8 (ch) mate.	

Ending, p. 114.

1.	Q to K8 (ch)
2. K to R2	B takes P (best)
3. R takes B	R takes RP (ch)
4. K or P takes R	Q mates accordingly.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Stettin.—Solutions correct; in the ending, 2. B takes P is the correct move.

Walter Waring.—Problem received with thanks.

W.—If R to Q4, there is no dual. Solutions of 93, 94, 95, 96, and End Game correct.

G. W.—Solutions of 93, 94, and 95 correct. In the Ending you will see that 2. B takes P is more forcible.

R. Sargeant.—The Endeavour, Vassal-road, Brixton; or the Surrey Chess Association, Hon. Sec., L. P. Rees, Annandale, Anerley.

Correct Solutions Received.—Problem No. 95, Ipswich. Problem No. 96, Stanley B. Baxter, Clarence, H. A. D., Berrow, H. A. L. S., Pursell's, Cornhill.

Contents of No. 97.

	Page		Page
How to Get Strong: In Middle and Advanced Life	145	American Mariners in Travelling By R. A. Proctor	154
The Birth and Growth of Myth. XV. By Edward Clodd	146	The Coloured Curtain in the Eye By William Ackroyd	155
Pretty Proofs of the Earth's Rotundity. (*Illus.*) By R. A. Proctor	147	The Harvest Moon. (*Illus.*) By R. A. Proctor	156
The Fisheries Exhibition. VI. (*Illus.*) By John Ernest Ady	149	Obituary: Death of Professor Tobin	157
Chemistry of the Cereals. V. By William Jago, F.C.S.	151	Correspondence: Punctuation and Printers, &c.	158
Folly and Courage at Niagara	152	Mathematics	160
The Whirlpool Rapids, Niagara	153	Our Chess Column	161

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